With September 2023 breaking global records, where does the UK sit?

Description

September 2023 was the world's warmest September on record for global average temperature according to the Copernicus Climate Change Service. The September average temperature was 16.38°C which is 0.93°C above the 1991-2020 average. This anomaly also made September 2023 the month with the highest difference to average of any month in any year in the ERA5 dataset which dates back to 1940.

The report also states the global temperature for January-September 2023 was 0.52°C higher than average, and 0.05°C higher than the equivalent period in the warmest calendar year (2016). You can read more about this announcement in the Copernicus September Climate Bulletin.

This significant global anomaly leads to the question of where the UK's climate for 2023 is compared to our observational record. So far for 2023 the first nine months of the year have been the second warmest on record for UK mean temperature, with records dating back to 1884. The mean temperature for the nine month period is 10.8°C, 0.9°C above the Jan-Sept 1991-2020 average.

The warmest UK January-September period on record is 2022, which ended up being the warmest year on record for the UK.

It is important to remember that when looking at smaller areas, such as the UK rather than the whole globe, the statistics become much more sensitive to variability in our weather. So, although the UK mean temperature is currently second warmest, it by no means guarantees that this ranking will be the same by the time we get to the end of the year. The figure will be highly dependent on the regimes that influence the UK's weather through October, November and December.

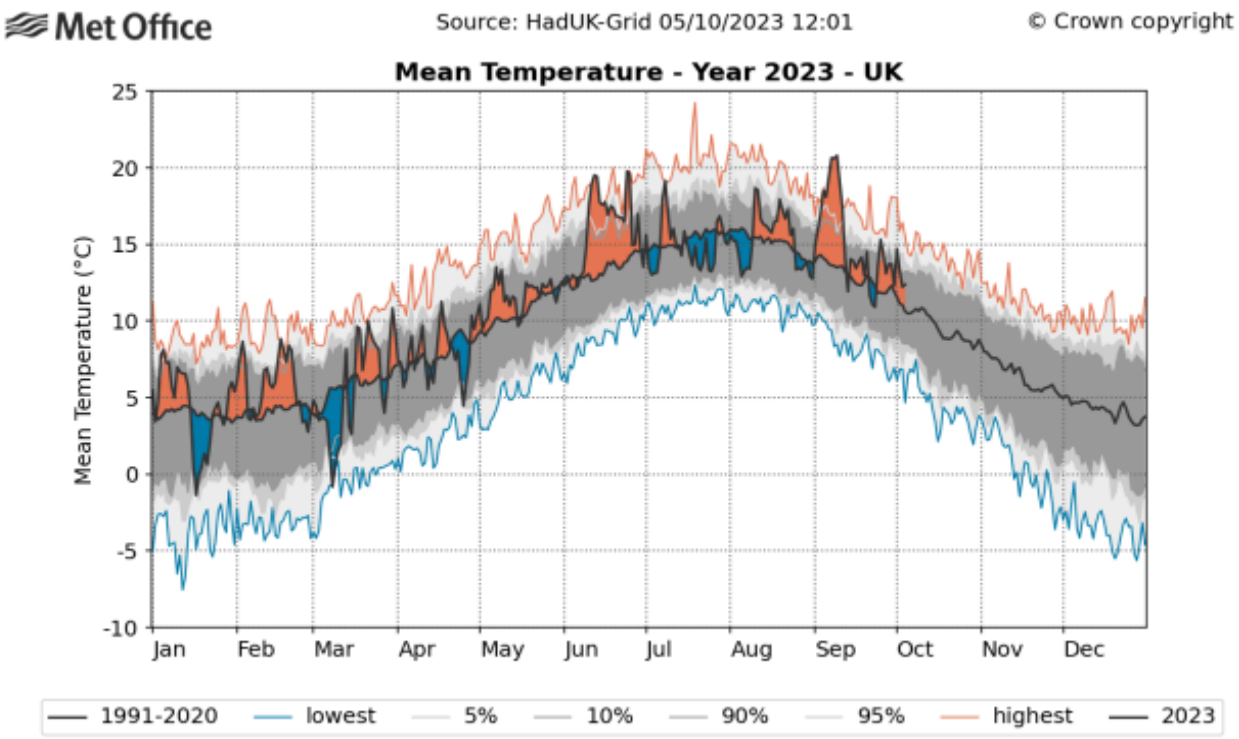
The UK's September climate statistics were published earlier this week, reporting that September 2023 was the joint-warmest September on record for the UK.

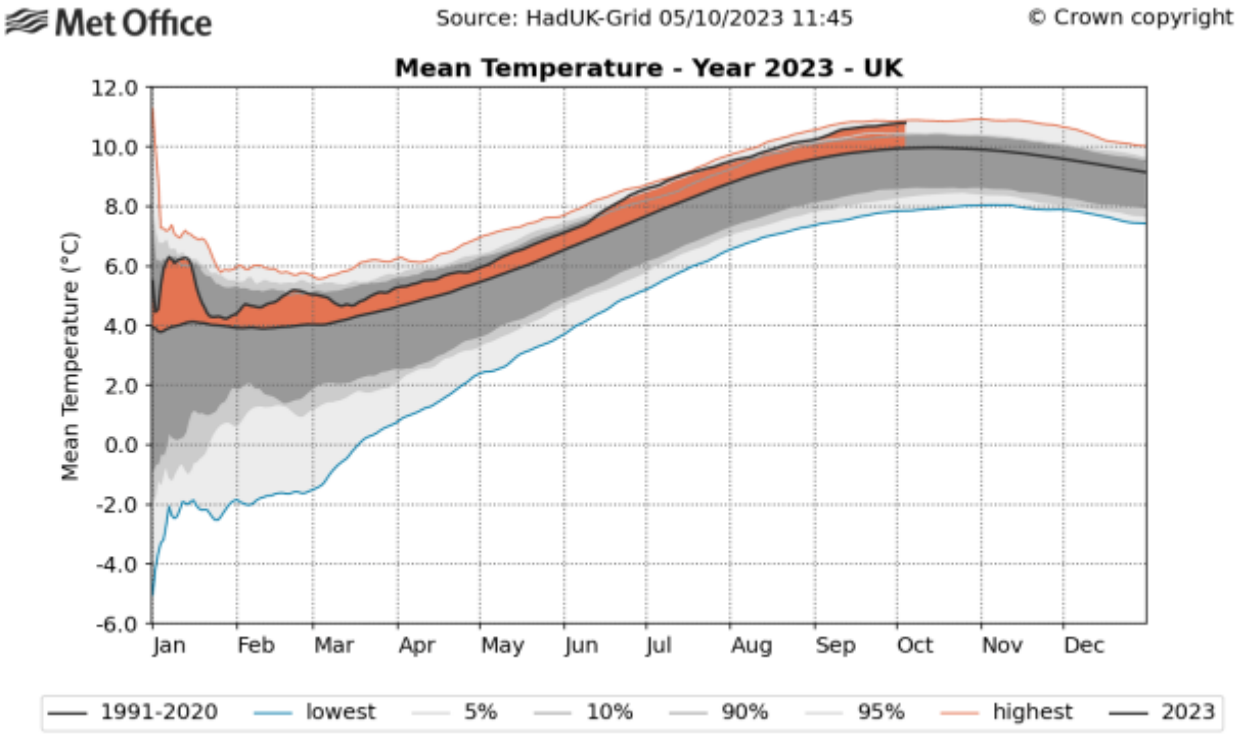
Dr Mark McCarthy from the Met Office's National Climate Information Centre, said: "The first nine months of 2023 have been the second warmest on record for the UK, following only 2022. There are however three months of the year still to go, and our weather in the UK can significantly influence these sorts of statistics. With this in mind, it is still possible that the ranking could change as we get closer to the end of the year."

The first graph below shows the UK daily mean temperature for each day of 2023 so far. The central thick black line is the 1991-2020 average UK temperature for each day, while the red and blue shading show spells of above and below average temperature through the year – in particular the warmth in June and early September and colder spells in mid-January, early March and late July to early August. Notably however there is much more red shading than blue meaning that overall the year so far has been warmer than average.

The second graph below shows the average UK mean temperature for 2023 as it has been monitored

for the year so far, compared at that point against all other years. This is effectively an accumulation of the shaded areas in the first graph. The lines on this graph tend to smooth out through the course of the year as the averaging period increases in length. The central thick black line is the 1991-2020 average UK temperature, the filled orange line is 2023 so far, with the record breaking year of 2022 sitting just above it.





Date Created

October 2023

Food security under pressure from climate change

Description

The UN define food security as when all individuals, at all times have physical, social and economic access to sufficient safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life.

Food security is under pressure from the direct impacts of climate change and food supply chains need to be better prepared and more resilient to deal with global shocks and the extremes of extreme weather.

Risks and impacts

The Intergovernmental Panel on Climate Change 2023 states: “The increase in extreme weather and climate events has exposed millions of people to acute food insecurity and reduced water security”.

This is particularly evident across communities in Africa, Asia, Central and South America and Small Island States. In some oceanic regions, ocean warming and ocean acidification have adversely affected food production, which leads to economic losses within the agriculture and fishery industries sensitive to these impacts.

In the UK, the UK Food Security Report 2021 identified climate change as a risk to the future of the UK food sector. The Report said: “The biggest medium to long term risk to the UK’s domestic production comes from climate change and other environmental pressures like soil degradation, water quality and biodiversity”.

We’re already seeing the influence of climate change with warmer, wetter winters and hotter, drier summers. UK Climate Projections indicate that this theme is likely to continue as our planet warms.

A warmer climate brings increased levels of evaporation as a warmer atmosphere can hold more moisture – approximately 7% more per 1°C of warming – when it rains, we can see higher totals, bringing an increase in flood risk. We’re also likely to see an increase in intense summer rainfall which could cause damage to crops at an important time of year in the cropping cycle.

Increased levels of evaporation can also lead to drier conditions and droughts becoming more impactful, leading to loss of soil moisture. This makes the land more vulnerable to erosion from wind and rainfall, significantly impacting soil health and putting increased risk on agricultural productivity.

Climate change is also likely to lead to a greater number of pests in the UK due to warmer and wetter conditions, especially in the winter months, by making conditions more favourable for some existing pests and increasing the likelihood of invasive non-native species (INNS). This presents serious risks to agricultural productivity and has ramifications for food security.

High temperatures such as those seen in the summer 2023 heatwave, combined with a lack of shade and wind, causes heat stress in animals. Earlier this year, Carbon Brief reported on how: “Thousands

of chickens – and more than a dozen pigs – died during transportation to slaughterhouses in England and Wales last summer due to heat-related stress. This marks a dramatic increase compared to the same period in 2021".

Prolonged exposure to heat stress will also lead to problems with milk yield and fertility. Farming UK reported: The record-breaking high temperatures in June may have cost UK dairy farmers more than a litre a day in lost milk production per cow.

Supporting policymakers

At the Met Office, we understand the strong sensitivities of the agricultural industry around weather and climate and the need to adapt to our changing weather and climate.

Our climate service on Food, Farming and Natural Environment has been running for over five years. It focuses on the impacts of climate change on farming and the food system. Funded by Defra, our science informs policymakers on the future adaptation needed in the agri-food sector. The climate service is working in collaboration with a range of partners to understand effective resilience and adaptation measures for UK agriculture and food. For example, in collaboration with Defra, Fera Science, University of Exeter and University of Warwick, we have developed a web tool for estimating priority pest emergence.

To support the Third National Adaptation Programme (NAP3) published earlier this year, Met Office scientists provided bespoke support to government departments to explore in more detail some of the 61 risks and opportunities identified in the UK's Third Climate Change Risk Assessment (CCRA3). Work is ongoing between the Met Office agri-food resilience service and Defra's crop breeding research programme – the Genetic Improvement Networks (GINs). This work explores the use of genetic technology as an adaptation measure, by developing new varieties of crops that are resilient to the hazards of the future UK climate.

Reducing the risks

Risks, projected adverse impacts and related losses and damages from climate change escalate with every increment of global warming. The IPCC states: “Keeping warming to 1.5°C above pre-industrial levels requires deep, rapid and sustained greenhouse gas emissions reductions in all sectors. Emissions should be decreasing by now and will need to be cut by almost half by 2030, if warming is to be limited to 1.5°C.”

The IPCC identify climate resilient development as a way forward, seeing wider benefits of integrating measures to adapt to climate change with actions to reduce emissions. Through the course of the month, you will see how Met Office scientists are supporting the agricultural industry to prepare for a changing climate and ensure it remains resilient to the risks of future climate change.

Get Climate Ready

The Met Office #GetClimateReady campaign aims to help people understand how even by making the smallest changes in our lives, we can all play a part in adapting our lives to protect ourselves from the climate impacts we will see.

We’re working with partner organisations to help provide advice on how individuals can tackle the many challenges of climate change. There are a range of everyday actions, which includes practical

quick wins for individuals, as well as actions which make the greatest impact. Our combined efforts can make a real difference.

Keep an eye on our Get ClimateReady webpages for a range of suggestions from our expert partners and follow #GetClimateReady across our social media channels to find out more.

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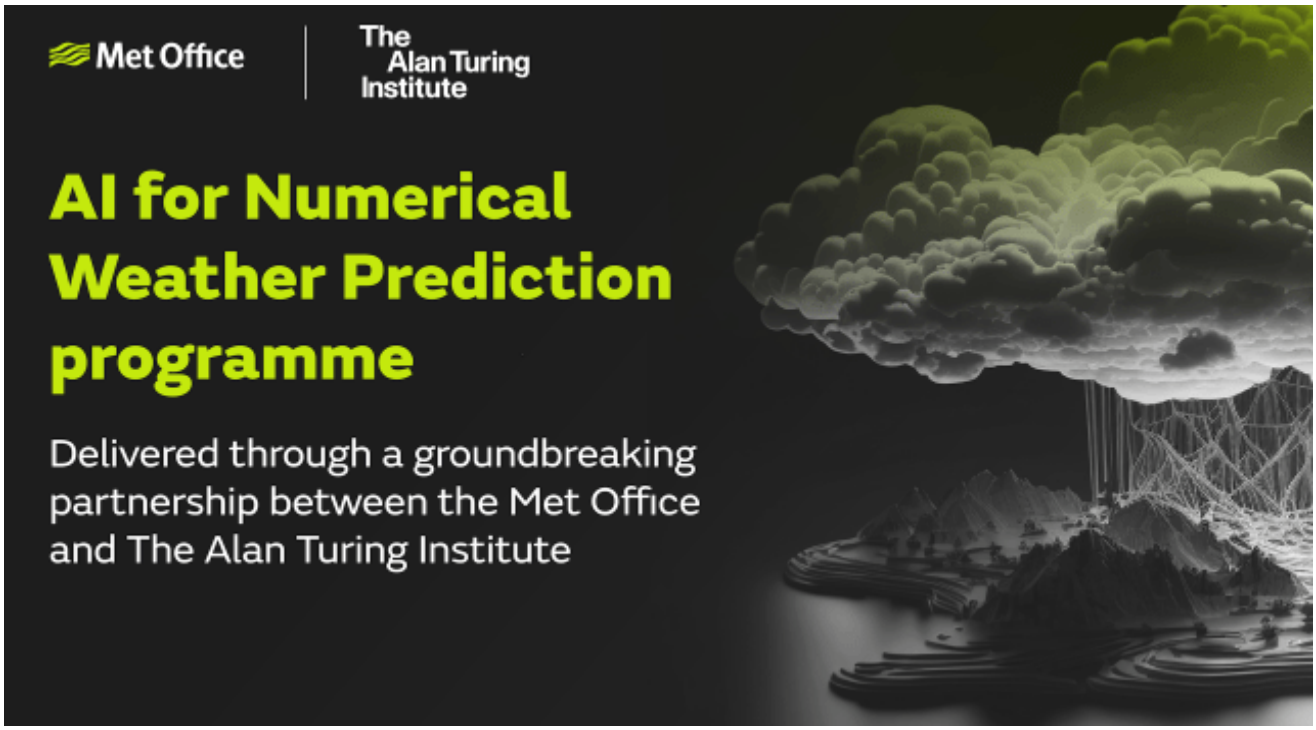
October 2023

Can AI transform how we forecast the weather?

Description

A partnership between the Turing and the Met Office aims to make weather forecasting more accurate and efficient write the Met Office's Professor Kirstine Dale and Dr Scott Hosking, senior research fellow at the Alan Turing Institute.


Met Office
The Alan Turing Institute
AI for Numerical Weather Prediction programme
Delivered through a groundbreaking partnership between the Met Office and The Alan Turing Institute

Our lives revolve around the weather. Checking the forecast helps us decide how to commute to work, when to hang the washing out and what to do at the weekend. Perhaps we don't think too deeply about what is involved in producing accurate forecasts. But our changing climate is causing more frequent and intense weather extremes and, as artificial intelligence (AI) algorithms advance at pace, scientists are starting to reimagine the weather forecast for a more volatile future.

The Alan Turing Institute is collaborating with the UK Met Office – a leading force in weather forecasting for over 160 years – to explore how AI and data science can enhance and even transform weather forecasting. This effort forms part of the Turing's Environment and Sustainability Grand Challenge (announced earlier this year), and it has the potential to benefit communities and businesses worldwide.

Why do we need to take weather forecasting to the next level?

Weather forecasting doesn't just dictate our daily lives. Accurate weather predictions, for example, help governments, emergency responders, the public and businesses prepare for extreme events such as storms, floods and heatwaves. Forecasts also inform decision-making in weather-sensitive sectors,

such as choosing harvesting times to improve crop yields or optimising national energy grids to make best use of renewable energy capacity.

A 2023 study estimated the global cost of extreme weather events in the past 20 years at £13m an hour, whilst UNICEF recently reported that extreme weather displaced 43m children over the past six years. This year has been another record-breaking year of extreme weather: flooding in South Korea, China, Greece and Libya, wildfires in Canada and around the Mediterranean, heatwaves across Europe , and unusually cold temperatures in Afghanistan. More recently, Storm Babet brought intense rainfall and winds to Europe, causing significant flooding across parts of the UK. Clearly, there is a need to make weather forecasting as accurate, computationally efficient and cost-effective as possible.

How does existing weather forecasting work?

Traditional weather forecasting relies mostly on complex numerical weather prediction (NWP) models – often consisting of millions of lines of computer code – which simulate the Earth's atmosphere using mathematical equations. These models require vast amounts of data, including atmospheric measurements, satellite observations and historical weather data, as well as powerful computational resources.

While NWP models have significantly improved over the years, they can struggle with forecasting local events such as showers, making predictions less accurate over certain regions and for specific events. Moreover, as more satellite sensors become available, it can be time-consuming to integrate new datasets of various modalities, resolutions and scales.

How does AI weather forecasting differ?

Rather than building modelling systems bottom-up using known physical principles, AI uses historical data to learn how weather patterns evolve. Machine learning algorithms are trained on vast quantities of existing data – including data from various satellites, surface sensors and the outputs of physics-based NWP models – to automatically recognise complex patterns in weather phenomena. These AI weather models can already compete with the current generation of NWP models and, for some applications, exceed their performance at a fraction of the computational cost.

Big tech companies including Google, Microsoft, Nvidia and Huawei have made significant advances in applying AI to weather prediction over the past two years. This has taken the international weather forecasting community by storm (pun intended), clearly demonstrating the potential of AI-powered weather models to complement traditional physics-based NWP models, especially for short-term forecasting. As AI algorithms and methods are developing so rapidly, we can expect to see even more advancements in the coming years, both within and outside the big tech labs. The low cost of producing AI forecasts means that they have the potential to democratise forecasting for the wider research community, benefitting people all over the world.

Our partnership presents an exciting opportunity to combine the Turing's AI and data science expertise with the Met Office's world-leading forecasting capabilities. Together, we aim to address some of the technical and logistical challenges that still face AI weather forecasting, such as:

- Data quality: High-quality, comprehensive data is essential for training AI models effectively. Ensuring data accuracy and availability is a priority.
- Model complexity: Developing AI models that can handle the intricacies of atmospheric science while remaining computationally efficient is a significant challenge.
- Integration: Integrating AI-based forecasting seamlessly into existing meteorological systems and workflows is crucial for practical implementation.
- Validation and verification: Rigorous testing and validation are needed to ensure the reliability and accuracy of AI weather forecasts.

Possible outcomes from our partnership include more accurate and timely prediction of extreme weather events (helping to save lives and protect critical national infrastructure); a greater breadth of user-focused weather forecasting services to aid decision-making across the public sector and private industry; and localised forecasts that can provide weather information at ever finer resolution.

Ultimately, our goal is to benefit individuals and industries, contributing to the global effort to build resilience to weather extremes. As AI continues to evolve and integrate into our lives, the outlook for the future of weather forecasting looks brighter than ever.

For more information on the first phase of our partnership, read our news release.

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